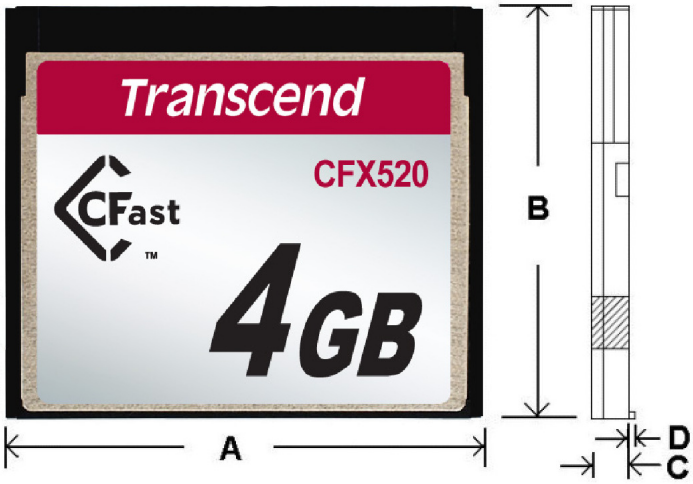
CFX520
CFast 1.1 Card

Transcend CFX520 memory cards are designed to satisfy the high performance requirement using a SATA 3Gb/s interface. As a removable device, it is easier to plug and remove in space-limited applications such as thin-clients and industrial PCs. Compliant with CFast 1.1 standard, CFX520 is your best choice as an embedded SATA storage solution.

Placement



Dimensions

Side	Millimeters	Inches
A	42.8+/-0.1	1.685+/-0.004
B	36.4+/-0.15	1.433+/-0.006
C	3.3+/-0.1	0.13+/-0.004
D	0.6+/-0.07	0.02+/-0.003

Features

- RoHS compliant
- CFast specification version 1.1 compliant
- Power supply: 3.3V±5%
- Operating temperature: -5ºC to 70ºC
- Storage temperature: -40ºC to 85ºC
- Humidity (Non condensation): 0% to 95%
- Built-in 72 bit per 1K Byte ECC (Error Correction Code) functionality to ensure high reliability of data transfer
- Global wear-leveling algorithm to eliminate excessive write operation and extend product life
- Supports S.M.A.R.T (Self-defined)
- Supports Security Command
- Fully compatible with devices and OS that support the SATA 3 Gb/s standard
- Durability of connector: 10,000 times

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Specifications

Physical Specification		
Form Factor		CFast 1.1
Storage Capacities		2GB to 8GB
Dimensions (mm)	**Length**	42.8 ± 0.1
	Width	36.4 ± 0.15
	Height	3.3 ± 0.1
Input Voltage		3.3V ± 5%
Weight		9.3g
Connector		7 + 17 pin female connector

Environmental Specifications		
Operating Temperature		-5 ℃ to 70 ℃
Storage Temperature		- 45 ℃ to 85 ℃
Humidity	**Operating**	0% to 95% (Non-condensing)
	Non-Operating	0% to 95% (Non-condensing)

Reliability	
Data Reliability	Supports BCH ECC 72 bit per 1K byte
Connector Durability	10,000 times
MTBF	1,000,000 hours

Regulations	
Compliance	CE, FCC and BSMI

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Performance

Model P/N	Read	Write	Random Read (4KB QD32)	Random Write (4KB QD32)
TS4GCFX520	97.43 MB/s	58.41 MB/s	13.79 MB/s	1.428 MB/s

Note: 25 ℃, test on GA-Z87-UD3H-CF, 2GB RAM, Windows® 7 with AHCI mode, benchmark utility Crystal DiskMark (version 3.0), copied file 1000MB.

Actual Capacity

Model P/N	User Max. LBA	Cylinder	Head	Sector
TS4GCFX520	7,835,184	7,773	16	63

Power Requirements

Input Voltage		3.3V ± 5%
Mode		**Max. (mA)**
TS4GCFX520	**Write**(peak)	214
	Read(peak)	171
	Idle(peak)	67

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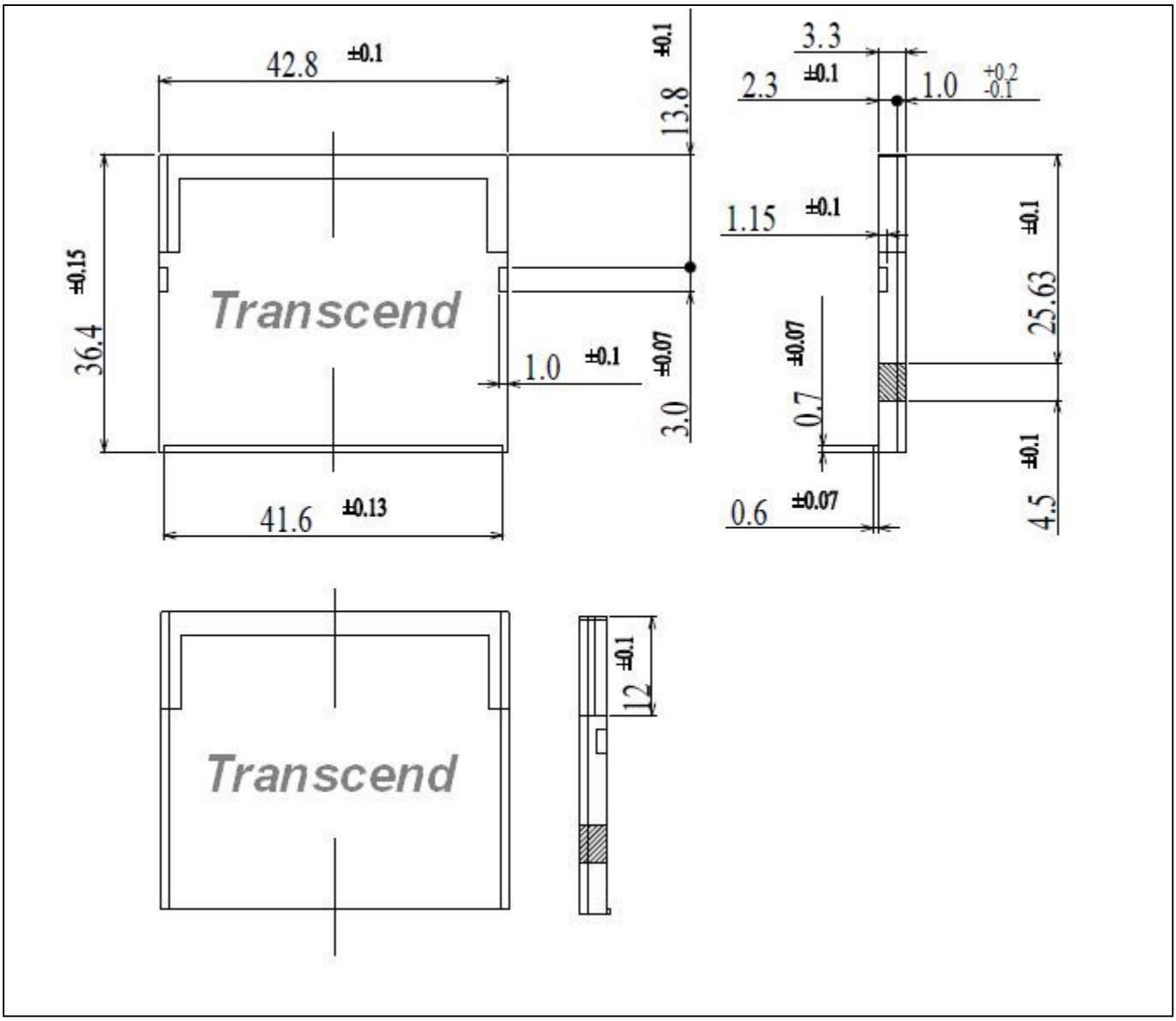
Package Dimensions

The figure below illustrates the Transcend CFX520. All dimensions are in mm.



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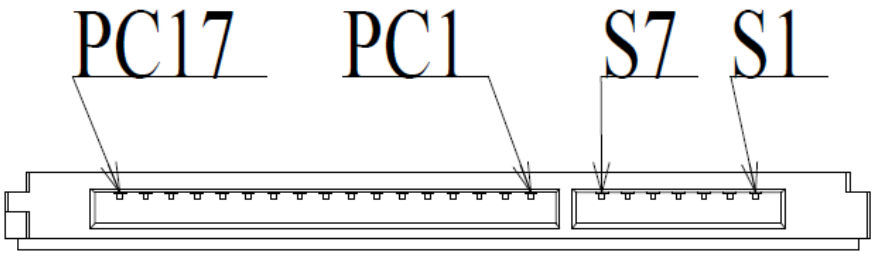
Pin Assignments

Pin No.	Pin Name
7-pin Signal Segment	
S1	GND
S2	A+
S3	A-
S4	GND
S5	B-
S6	B+
S7	GND
17-pin Power Segment	
PC1	CDI
PC2	GND
PC3	DEVSLP
PC4	NC
PC5	NC
PC6	NC
PC7	GND
PC8	LED_DAS
PC9	LED_SATA
PC10	NC
PC11	NC
PC12	NC
PC13	3.3V
PC14	3.3V
PC15	GND
PC16	GND
PC17	CDO

Pin Layout



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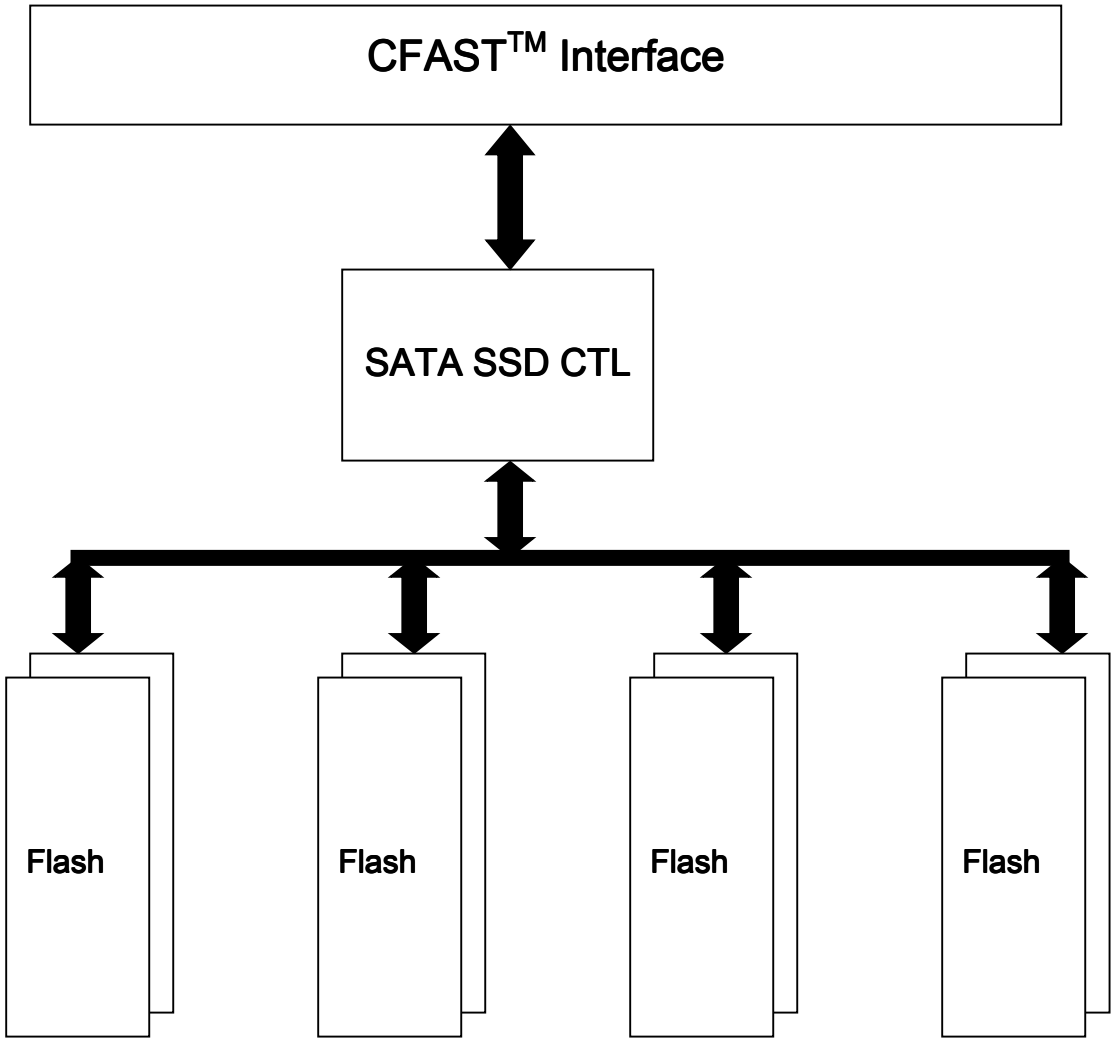
Block Diagram



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Reliability

Wear-Leveling algorithm

The controller supports static/dynamic wear leveling. When the host writes data, the controller will find and use the block with the lowest erase count among the free blocks. This is known as dynamic wear leveling. When the free blocks' erase count is higher than a threshold value plus data blocks', it will activate the static wear leveling, replacing the less frequently used user blocks with the high erase count free blocks.

ECC algorithm

Using 72 bit BCH Error Correction Code with each channel, the controller can correct 72 random bits per 1 KByte data sector for a SLC NAND flash. The hardware executes parity generation and error detection/correction features.

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ATA command register

This table and the following paragraphs summarize the ATA command set.

Support ATA/ATAPI Command	Code	Protocol
General Feature Set		
EXECUTE DIAGNOSTICS	90h	Device diagnostic
FLUSH CACHE	E7h	Non-data
IDENTIFY DEVICE	ECh	PIO data-In
INITIALIZE DRIVE PARAMETERS	91h	Non-data
READ DMA	C8h	DMA
READ MULTIPLE	C4h	PIO data-In
READ SECTOR(S)	20h or 21h	PIO data-In
READ VERIFY SECTOR(S)	40h or 41h	Non-data
SET FEATURES	EFh	Non-data
SET MULTIPLE MODE	C6h	Non-data
WRITE DMA	CAh	DMA
WRITE MULTIPLE	C5h	PIO data-out
WRITE SECTOR(S)	30h or 31h	PIO data-out
NOP	00h	Non-data
READ BUFFER	E4h	PIO data-In
WRITE BUFFER	E8h	PIO data-out
Power Management Feature Set		
CHECK POWER MODE	E5h or 98h	Non-data
IDLE	E3h or 97h	Non-data
IDLE IMMEDIATE	E1h or 95h	Non-data
SLEEP	E6h or 99h	Non-data
STANDBY	E2h or 96h	Non-data
STANDBY IMMEDIATE	E0h or 94h	Non-data
Security Mode Feature Set		
SECURITY SET PASSWORD	F1h	PIO data-out
SECURITY UNLOCK	F2h	PIO data-out
SECURITY ERASE PREPARE	F3h	Non-data
SECURITY ERASE UNIT	F4h	PIO data-out
SECURITY FREEZE LOCK	F5h	Non-data
SECURITY DISABLE PASSWORD	F6h	PIO data-out
SMART Feature Set		
SMART Disable Operations	B0h	Non-data
SMART Enable/Disable Autosave	B0h	Non-data
SMART Enable Operations	B0h	Non-data
SMART Return Status	B0h	Non-data
SMART Execute Off-Line Immediate	B0h	Non-data
SMART Read Data	B0h	PIO data-In
SMART Read Threshold	B0h	PIO data-In
SMART Save Attribute Values	B0h	Non-data
Host Protected Area Feature Set		
Read Native Max Address	F8h	Non-data
Set Max Address	F9h	Non-data
Set Max Set Password	F9h	PIO data-out

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Set Max Lock	F9h	Non-data
Set Max Freeze Lock	F9h	Non-data
Set Max Unlock	F9h	PIO data-out
48-bit Address Feature Set		
Flush Cache Ext	EAh	Non-data
Read Sector(s) Ext	24h	PIO data-In
Read DMA Ext	25h	DMA
Read Multiple Ext	29h	PIO data-In
Read Native Max Address Ext	27h	Non-data
Read Verify Sector(s) Ext	42h	Non-data
Set Max Address Ext	37h	Non-data
Write DMA Ext	35h	DMA
Write DMA FUA Ext	3Dh	DMA
Write Multiple Ext	39h	PIO data-out
Write Multiple FUA Ext	CEh	PIO data-out
Write Sector(s) Ext	34h	PIO data-out
CFA Feature Set		
Request Sense	03h	Non-data
Write Sectors Without Erase	38h	PIO data-out
Erase Sectors	C0h	Non-data
Write Multiple Without Erase	CDh	PIO data-out
Translate Sector	87h	PIO data-In
Set Features Enable/Disable 8 bit Transfer	EFh	Non-data
Others		
Seek	70h	Non-data
Wear Level	F5h	Non-data

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ATA Command Specifications

FLUSH CACHE (E7h)

This command is used by the host to request the device to flush the write cache. If there is data in the write cache, that data shall be written to the media. The BSY bit shall remain set to one until all data has been successfully written or an error occurs.

IDENTIFY DEVICE (ECh)

This command reads out 512Bytes of drive parameter information. Parameter Information consists of the arrangement and value as shown in the following table. This command enables the host to receive the Identify Drive Information from the device.

READ DMA (C8h)

Read data from sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value. A sector count of zero requests 256 sectors.

READ MULTIPLE (C4h)

This command performs similarly to the Read Sectors command. Interrupts are not generated on each sector, but on the transfer of a block which contains the number of sectors defined by a Set Multiple command.

READ SECTOR(S) (20h)

This command reads 1 to 256 sectors as specified in the Sector Count register from sectors which is set by Sector number register. A sector counts of 0 requests 256 sectors. The transfer beings specified in the Sector Number register.

READ VERIFY SECTOR(S) (40h/41h)

This command verifies one or more sectors on the drive by transferring data from the flash media to the data buffer in the drive and verifying that the ECC is correct. This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host.

SET FEATURES (EFh)

This command set parameter to Features register and set drive's operation. For transfer mode, parameter is set to Sector Count register. This command is used by the host to establish or select certain features.

SET MULTIPLE MODE (C6h)

This command enables the device to perform READ MULTIPLE and WRITE MULTIPLE operations and establishes the block count for these commands.

WRITE DMA (CAh)

Write data to sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value.

WRITE MULTIPLE (C5h)

This command is similar to the Write Sectors command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

WRITE SECTOR(S) (30h/31h)

Write data to a specified number of sectors (1 to 256, as specified with the Sector Count register) from the specified address. Specify "00h" to write 256 sectors.

NOP (00h)

The device shall respond with command aborted. For devices implementing the Overlapped feature set, subcommand code 00h in the Features register shall abort any outstanding queue. Subcommand codes 01h through FFh in the Features register shall not affect the status of any outstanding queue.

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READ BUFFER (E4h)

The READ BUFFER command enables the host to read a 512-byte block of data.

WRITE BUFFER (E8h)

This command enables the host to write the contents of one 512-byte block of data to the device's buffer.

Power Management Feature Set

CHECK POWER MODE (E5h or 98h)
The host can use this command to determine the current power management mode.

IDLE (E3h or 97h)

This command causes the device to set BSY, enter the Idle mode, clear BSY and generate an interrupt. If sector count is non-zero, the automatic power down mode is enabled. If the sector count is zero, the automatic power mode is disabled.

IDLE IMMEDIATE (E1h or 95h)
This command causes the device to set BSY, enter the Idle(Read) mode, clear BSY and generate an interrupt.

SLEEP (E6h or 99h)
This command causes the device to set BSY, enter the Sleep mode, clear BSY and generate an interrupt.

STANDBY (E2h or 96h)
This command causes the device to set BSY, enter the Sleep mode (which corresponds to the ATA "Standby" Mode), clear BSY and return the interrupt immediately.

STANDBY IMMEDIATE (E0h or 94h)
This command causes the drive to set BSY, enter the Sleep mode (which corresponds to the ATA "Standby" Mode), clear BSY and return the interrupt immediately.

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Security Mode Feature Set

SECURITY SET PASSWORD (F1h)

This command sets user password or master password. The host outputs sector data with PIO data-out protocol to indicate the information defined in the following table.

Security set Password data content1

Word	Content		
0	Control word		
	Bit 0	Identifier	0=set user password 1=set master password
	Bits 1-7	Reserved	
	Bit 8	Master Password Capability	0=High 1=Maximum
	Bits 9-15	Reserved	
1-16	Password (32 bytes)		
17	Master Password identifier. This word is valid if word 0 bit 0 is set to one.		
18-255	Reserved		

SECURITY UNLOCK (F2h)

This command disables LOCKED MODE of the device. This command transfers 512 bytes of data from the host with PIO data-out protocol. The following table defines the content of this information

Security Unlock information2

Word	Content		
0	Control word		
	Bit 0	Identifier	0=compare user password 1=compare master password
	Bits 1-15	Reserved	
1-16	Password (32 bytes)		
17-255	Reserved		

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SECURITY DISABLE PASSWORD (F6h)

Disables any previously set user password and cancels the lock. The host transfers 512 bytes of data, as shown in the following table, to the drive. The transferred data contains a user or master password, which the drive compares with the saved password. If they match, the drive cancels the lock. The master password is still saved. It is re-enabled by issuing the SECURITY SET PASSWORD command to re-set a user password.

SECURITY ERASE PREPARE (F3h)

This command shall be issued immediately before the Security Erase Unit command to enable erasing and unlocking. This command prevents accidental loss of data on the drive.

SECURITY ERASE UNIT (F4h)

The host uses this command to transfer 512 bytes of data, as shown in the following table, to the drive. The transferred data contains a user or master password, which the drive compares with the saved password. If they match, the drive deletes user data, disables the user password, and cancels the lock. The master password is still saved. It is re-enabled by issuing the SECURITY SET PASSWORD command to re-set a user password.

SECURITY FREEZE LOCK (F5h)

Causes the drive to enter Frozen mode. Once this command has been executed, the following commands to update a lock result in the Aborted Command error:

- SECURITY SET PASSWORD
- SECURITY UNLOCK
- SECURITY DISABLE PASSWORD
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT

The drive exits from Frozen mode upon a power-off or hard reset. If the SECURITY FREEZE LOCK command is issued when the drive is placed in Frozen mode, the drive executes the command and stays in Frozen mode.

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Identify Device Information Default Value

Word Address	Default Value	Total Bytes	Data Field Type Information
0	044Ah	2	General configuration
1	XXXXh	2	Default number of cylinders
2	0000h	2	Reserved
3	00XXh	2	Default number of heads
4	0000h	2	Obsolete
5	0240h	2	Obsolete
6	XXXXh	2	Default number of sectors per track
7-8	XXXXh	4	Number of sectors per card (Word 7 = MSW, Word 8 = LSW)
9	0000h	2	Obsolete
10-19	XXXXh	20	Serial number in ASCII (Right Justified)
20	0002h	2	Obsolete
21	0002h	2	Obsolete
22	0004h	2	Obsolete
23-26	XXXXh	8	Firmware revision in ASCII. Big Endian Byte Order in Word
27-46	XXXXh	40	Model number in ASCII (Left Justified) Big Endian Byte Order in Word
47	8001h	2	Maximum number of sectors on Read/Write Multiple command
48	0000h	2	Reserved
49	0F00h	2	Capabilities
50	4000h	2	Capabilities
51	0200h	2	PIO data transfer cycle timing mode
52	0000h	2	Obsolete
53	0007h	2	Field Validity
54	XXXXh	2	Current numbers of cylinders
55	XXXXh	2	Current numbers of heads
56	XXXXh	2	Current sectors per track
57-58	XXXXh	4	Current capacity in sectors (LBAs)(Word 57 = LSW, Word 58 = MSW)
59	0101h	2	Multiple sector setting
60-61	XXXXh	4	Total number of sectors addressable in LBA Mode
62	0000h	2	Reserved
63	0007h	2	Multiword DMA transfer. Supports MDMA Mode 0,1,and 2
64	0003h	2	Advanced PIO modes supported
65	0078h	2	Minimum Multiword DMA transfer cycle time per word.
66	0078h	2	Recommended Multiword DMA transfer cycle time.
67	0078h	2	Minimum PIO transfer cycle time without flow control

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Word Address	Default Value	Total Bytes	Data Field Type Information
68	0078h	2	Minimum PIO transfer cycle time with IORDY flow control
69-74	0000h	12	Reserved
75	0000h	2	Queue depth
76	0006h	2	Serial ATA capacities · Supports Serial ATA Gen1 · Supports Serial ATA Gen2
77	0000h	2	Reserved
78	0008h	2	Device supports initiating power management
79	0000h	2	Reserved
80	03F0h	2	Mijor version number (ATA8-ACS)
81	0000h	2	Minor version number
82	742Bh	2	Command sets supported 0
83	7500h	2	Command sets supported 1
84	4023h	2	Command sets supported 2
85-87	XXXXh	6	Command set/feature enabled
88	007Fh	2	Ultra DMA Mode Supported and Selected
89	0003h	2	Time required for Security erase unit completion
90	0001h	2	Time required for an Enhanced Erase mode Security Erase Unit command
91	0000h	2	Current Advanced power management value
92	FFFEh	2	Master Password Revision Code
93-99	0000h	14	Reserved
100-103	XXXXh	8	Maximum user LBA for 48-bit address feature set
104-127	0000h	48	Reserved
128	0001h	2	Security status
129-159	0000h	62	Vendor uniqure bytes
160	0000h	2	Power requirement description
161	0000h	2	Reserved
162	0000h	2	Key management schemes supported
163	0000h	2	CF Advanced True IDE Timing Mode Capability and Setting
164-216	0000h	106	Reserved
217	0001h	2	Non-rotating media (SSD)
218-255	0000h	76	Reserved

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SMART Command Support

Value	Command	Value	Command
D0h	Read Data	D5h	Reserved
D1h	Read Attribute Threshold	D6h	Reserved
D2h	Enable/Disable Autosave	D8h	Enable SMART Operations
D3h	Save Attribute Values	D9h	Disable SMART Operations
D4h	Execute OFF-Line Immediate	DAh	Return Status

If the reserved size is below a threshold, status can be read from the Cylinder Register using the Return Status command (DAh).

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SMART DATA Structure

BYTE	F / V	Description
0-1	X	Revision code
2-361	X	Vendor specific
362	V	Off-line data collection status
363	X	Self-test execution status byte
364-365	V	Total time in seconds to complete off-line data collection activity
366	X	Vendor specific
367	F	Off-line data collection capability
368-369	F	SMART capability
370	F	Error logging capability 7-1 Reserved 0 1=Device error logging supported
371	X	Vendor specific
372	F	Short self-test routine recommended polling time (in minutes)
373	F	Extended self-test routine recommended polling time (in minutes)
374	F	Conveyance self-test routine recommended polling time (in minutes)
375-385	R	Reserved
386-395	F	Firmware Version/Date Code
396-399	F	Reserved
400-406	V	'SMI2244LT'
407-415	X	Vendor specific
416	F	Reserved
417	F	Program/write the strong page only
418-419	V	Number of spare block
420-423	V	Average erase count
424-510	X	Vendor specific
511	V	Data structure checksum

F=the content of the byte is fixed and does not change.

V=the content of the byte is variable and may change depending on the state of the device or the commands executed by the device.

X=the content of the byte is vendor specific and may be fixed or variable.

R=the content of the byte is reserved and shall be zero.

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SMART Attributes

The table below shows the vendor specific data in byte 2 to 361 of the 512-byte SMART data

Attribute ID (hex)	Raw Attribute Value						Attribute Name
01	MSB	00	00	00	00	00	Read Error Rate
05	LSB	MSB	00	00	00	00	Reallocated sectors count
09	LSB	MSB	00	00	00	00	Reserved
0C	LSB	MSB	00	00	00	00	Power Cycle Count
A0	LSB	-	-	MSB	00	00	Uncorrectable sectors count when read/write
A1	LSB	MSB	00	00	00	00	Number of valid spare blocks
A2	LSB	MSB	00	00	00	00	Number of Child pair
A3	LSB	MSB	00	00	00	00	Number of initial invalid blocks
A4	LSB	-	-	MSB	00	00	Total erase count
A5	LSB	-	-	MSB	00	00	Maximum erase count
A6	LSB	-	-	MSB	00	00	Minimum erase count
A7	LSB	-	-	MSB	00	00	Average erase count
C0	LSB	-	-	MSB	00	00	Power-off retract Count (Fujitsu: Emergency Retract Cycle Count)
C2	MSB	00	00	00	00	00	Controlled temperature
C3	LSB	-	-	MSB	00	00	Hardware ECC recovered
C4	LSB	-	-	MSB	00	00	Reallocation event count
C6	LSB	-	-	MSB	00	00	Reserved
C7	LSB	MSB	00	00	00	00	UltraDMA CRC Error Count
F1	LSB	-	-	MSB	00	00	Total LBA written (each write unit = 32MB)
F2	LSB	-	-	MSB	00	00	Total LBA read (each read unit = 32MB)

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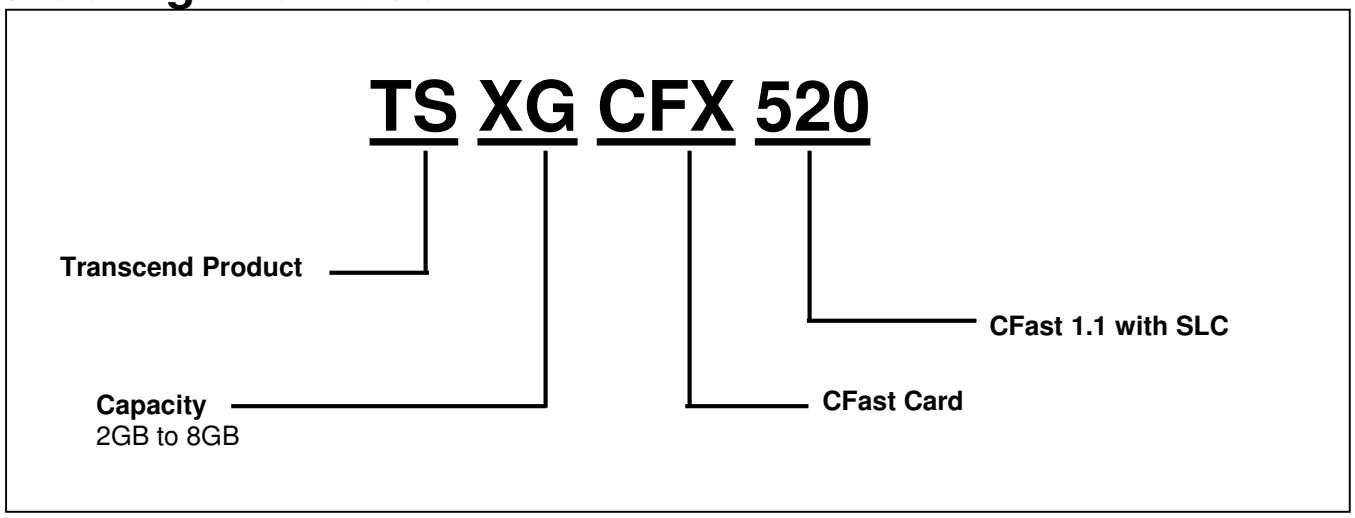
Ordering Information



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Revision History			
Version	**Date**	**Modification Content**	**Modified Page**
V0.1	2014/08/06	Initial beta release	
V1.0	2014/09/10	Initial release	

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